EJERCICIO PRODUCTO CRUZ EN $\mathbb{R}^3$

Calcule $\boldsymbol{u} \times \boldsymbol{v}$ para los siguientes vectores.

a) $\boldsymbol{u} = 2\hat{\imath} + 3\hat{\jmath} + 4\hat{k}$, $\boldsymbol{v} = -\hat{\imath} + 3\hat{\jmath} - \hat{k}$

b) $\boldsymbol{u} = (1, 0, 1)$, $\boldsymbol{v} = (2, 3, -1)$

c) $\boldsymbol{u} = \hat{\imath} - \hat{\jmath} + 2\hat{k}$, $\boldsymbol{v} = 3\hat{\imath} - 4\hat{\jmath} + \hat{k}$

d) $\boldsymbol{u} = (2, -1, 1)$, $\boldsymbol{v} = -2\boldsymbol{u}$

Solución

a)

```
sage] u=vector([2,3,4])
sage] v=vector([-1,3,-1])
sage] i=matrix([[u[1],u[2]],[v[1],v[2]]])
sage] i.det()
```

-15

```
sage] j=matrix([[u[0],u[2]],[v[0],v[2]]])
sage] -j.det()
```

-2

```
sage] k=matrix([[u[0],u[1]],[v[0],v[1]]])
sage] k.det()
```

9

Por lo tanto $\boldsymbol{u} \times \boldsymbol{v} = -15\hat{\imath} - 2\hat{\jmath} + 9\hat{k}$.

b)

```
sage] u=vector([1,0,1])
sage] v=vector([2,3,-1])
sage] i=matrix([[u[1],u[2]],[v[1],v[2]]])
sage] i.det()
```

-3

```
sage] j=matrix([[u[0],u[2]],[v[0],v[2]]])
sage] -j.det()
```

3

```
sage] k=matrix([[u[0],u[1]],[v[0],v[1]]])
sage] k.det()
```

3

Por lo tanto $\boldsymbol{u} \times \boldsymbol{v} = -3\hat{\imath} + 3\hat{\jmath} + 3\hat{k}$.

c)

```
sage] u=([1,-1,2])
sage] v=([3,-4,1])
sage] i=matrix([[u[1],u[2]],[v[1],v[2]]])
```

```
sage] i.det()
```

7

```
sage] j=matrix([[u[0],u[2]],[v[0],v[2]]])
sage] -j.det()
```

5

```
sage] k=matrix([[u[0],u[1]],[v[0],v[1]]])
sage] k.det()
```

-1

Por lo tanto $\boldsymbol{u} \times \boldsymbol{v} = 7\hat{\imath} + 3\hat{\jmath} - 1\hat{k}$.

d)

```
sage] u=vector([2,-1,1])
sage] v=-2*u
sage] i=matrix([[u[1],u[2]],[v[1],v[2]]])
sage] i.det()
```

0

```
sage] j=matrix([[u[0],u[2]],[v[0],v[2]]])
sage] -j.det()
```

0

```
sage] k=matrix([[u[0],u[1]],[v[0],v[1]]])
sage] k.det()
```

0

Por lo tanto $\boldsymbol{u} \times \boldsymbol{v} = 0\hat{\imath} + 0\hat{\jmath} + 0\hat{k}$.